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Impact of Apple Pomace Powder on the Bioactivity, and the Sensory and Textural Characteristics of Yogurt

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Abstract: This study focused on the development of a yogurt with an improved structure, texture and antioxidant activity level, by using apple pomace (AP) powder that was obtained in large quantities during the production of juices. The objective was to determine the sensory, physicochemical, textural and antioxidant characteristics of yogurt with the addition of AP powder (0.2–1.0%), during its shelf life. The physicochemical composition of AP was determined as follows: dietary fibers—62.73%, including pectin—23.12%; and the content of the antioxidant compounds in AP—total polyphenols (728.8 mg GAE/100 g DW), flavonoids (246.5 mg QE/100 g DW), tannins (63.54 mg TAE/100 g DW), carotenoids (4.93 mg/100 g DW) and the ability to inhibit the free radical (2433 µmol TE/100 g DW). AP addition reduces the yogurt fermentation time. The increase in the total dietary fiber content of up to 0.63% and in the insoluble fiber of up to 0.14% was attested in this study, as well as a significant increase in antioxidant activity, which correlated to the AP content. The addition of AP improved the textural properties of the yogurt during storage (20 days) and led to a significant reduction in syneresis. The influence of the AP content and the storage period on the textural characteristics and the overall acceptability of the yogurt samples were analyzed by the mutual information method. The AP content greatly influenced the yogurt's quality, with the information analysis value for the overall acceptability being 0.965 bits. The analysis of the sensory and textural parameters of the yogurt during storage (1–20 days) demonstrated that samples with AP in proportions of 0.6–0.8% were evaluated with the highest score.

Keywords: apple pomace powder; dietary fiber; yogurt; textural parameters; antioxidant activity; and quality

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1. Introduction

Food industries produce millions of tons of waste during processing, which becomes a significant environmental, economic and nutritional problem. Agricultural waste could serve as an important source of bioactive compounds, including antioxidants, dietary fibers, polysaccharides, vitamins, carotenoids, pigments and oils [1]. These compounds are of increasing scientific interest due to the benefits they bring to human life [2].

Among fruit wastes, apple pomace (AP) is a potential source of phytochemicals and contains significant amounts of carbohydrates, as well as small amounts of proteins, vitamins and minerals [3]. It has been estimated that the production of apple juice results in a product that is low in polyphenolic compounds and that has only 3–10% of the antioxidant activity of the fruit from which it is produced. Most of the polyphenol compounds remain in apple pomace—a heterogeneous mixture of peel, core, seed, stem and soft tissue [4]. Currently, there are few uses of AP, with most of it being used on farms as animal feed or transported to landfills and incinerators. Sad to say, this has a negative effect on the environment, contributing to the greenhouse effect [5].

AP contains insoluble sugars, including cellulose (127.9 g/kg dried weight (DW)); hemicellulose (7.2–43.6 g/kg DW); lignin (15.3–23.5 g/kg DW); and simple sugars, such as glucose, fructose and galactose [5,6]. In addition, AP is an important source of substances

with high antioxidant activity, in particular, quercetin glycosides, phloridzin, phloretin, epicatechin, chlorogenic acid and other polyphenolic constituents [7–10]. Therefore, AP can be used in various food systems after minimal processing or in the form of extracts, significantly increasing the functional value of food and contributing to a reduction in food waste [6].

Yogurt plays an essential role in most dietary recommendations, providing nutrients and bioactive compounds that are essential for health, such as the following: vitamins and minerals in an easily assimilable form; lactose; bioactive proteins; lipids; and live lactic bacteria, which is beneficial to the gastrointestinal tract [11]. To meet consumer needs, new assortments of yogurt-based products are being investigated, leading to a steady increase in the sales and popularity of this dairy product [12].

Yogurt is a product that is characterized by an unstable structure, which is vulnerable to deformation by shearing, with only a slight recovery at rest or under the action of a low shearing speed [13]. The microstructure of milk protein gels and their rheological properties affect the texture, sensory properties and storage stability of yogurt [14]. The main factors that affect the structure and texture of yogurt are as follows: the protein and fat content, the technological process, and the amount and properties of the added ingredients [14–17].

The structure and texture of yogurt is controlled, most often, by the addition of stabilizers. The most common food stabilizers and thickeners are various polysaccharides, such as modified starch, xanthan, carrageenan, methyl and hydroxypropylmethyl cellulose, etc. [18]. These polysaccharides interact with the casein network and contribute to the formation of gels in biphasic systems (liquid–solid): a three-dimensional, continuous structure that forms the gel matrix, which holds a finely dispersed liquid phase [19]. Although these food additives are considered safe by regulatory agencies, they are perceived as harmful by consumers due to their unfamiliarity and the risk perception of chemicals [20].

Therefore, the objective of this study was to determine the sensory, physicochemical, textural and antioxidant characteristics of yogurt with the addition of AP powder, during its shelf life. This study focused on the development of a yogurt with an improved structure and texture, and improved antioxidant activity by using AP powder.

Conflicts of Interest: The authors declare no conflict of interest.

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